THE MONTHLY EVENING SKY MAP

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The Stars Brought Down To Earth

VOL. LIV NO. 504

FIFTY CENTS

MARCH • APRIL 1960

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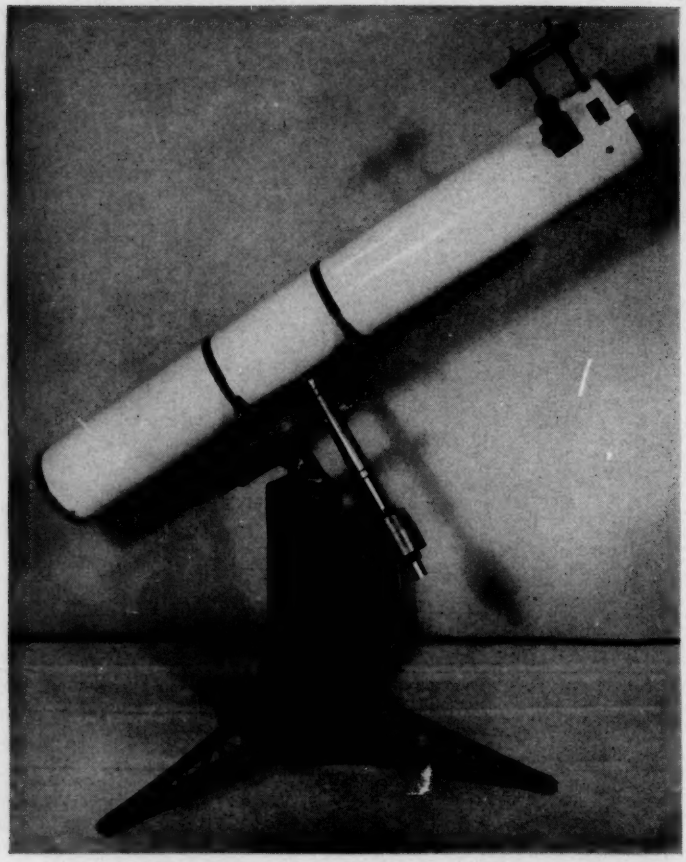

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LEON BARRITT

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COVER PICTURE

Too large to be termed a mere crater, the lunar ringed plain Copernicus is one of the most striking surface features of the moon. Seen in the twilight of the terminator line, its circular walls rise massively, while at or near full moon its system of rays—still unexplained—catch the eye and the imagination. To the left of Copernicus is the crater and central peak of Eratosthenes; below rise the Carpathian mountains, which border the Mare Imbrium. This photo was made with the 36-inch refractor of the Lick Observatory.

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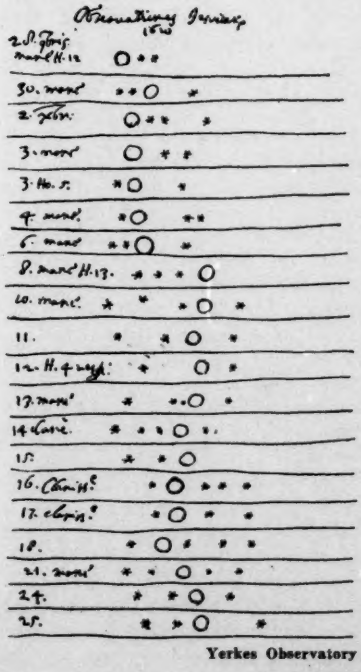

Yerkes Observatory

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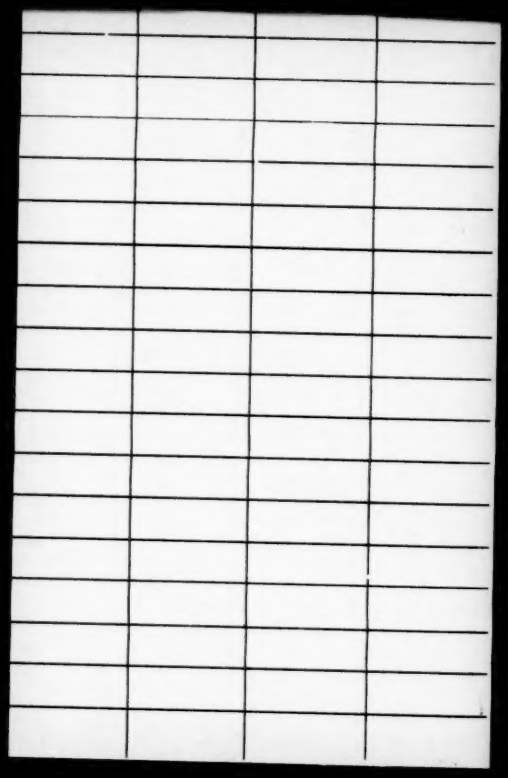

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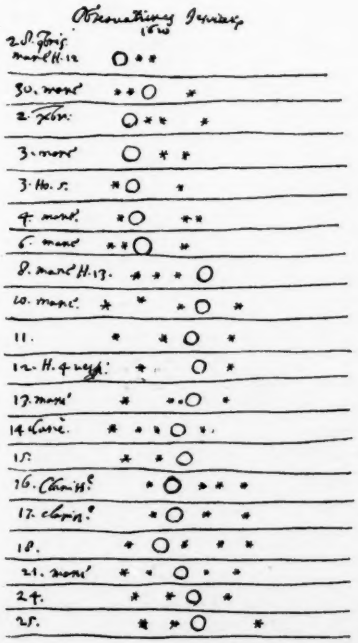

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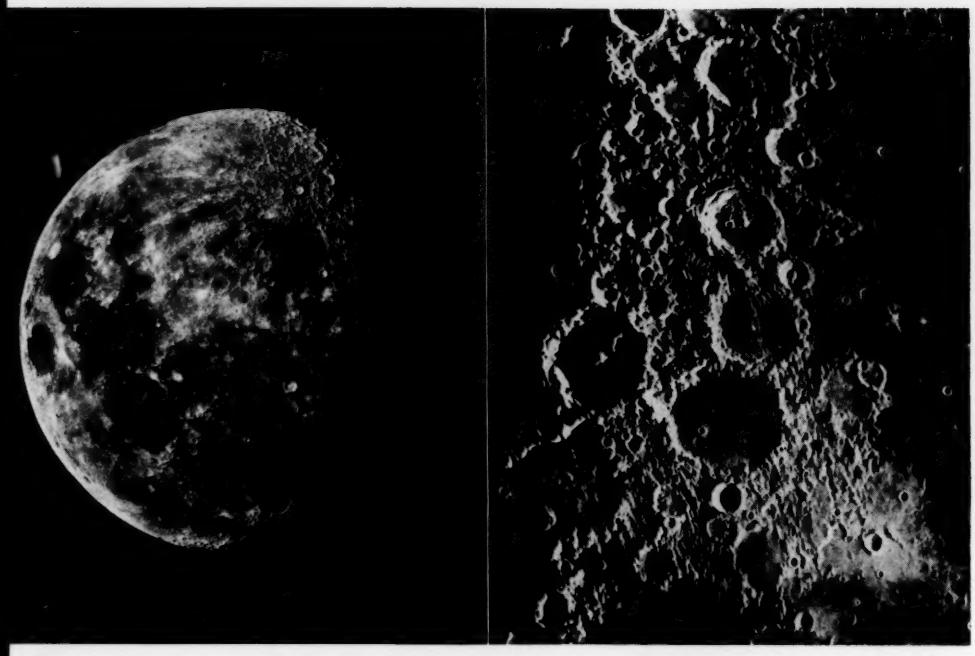


(Left) The moon at ten days, between first quarter and full. A three-inch telescope can give a similar view of the lunar terrain at moderate power. (Right) An object of special interest to telescopists is this lunar escarpment, or Straight Wall, as it is called. Lying just to the west (photos all inverted) of the crater Birt, the Wall is readily visible in a small instrument when near the terminator. Examine it both before and after full moon to compare shadow effects and determine which side of the fault is higher. Straight Wall is located in southeastern sector above Copernicus, and is just visible on photo at left. Lick Observatory Photographs.

THROUGH THE THREE-INCH

THROUGHOUT the literature of astronomical observation you will read the "confessions" of experienced observers, in which they bare to the world the fact that, although they proudly claim ownership of large and impressive telescopes, much of their observations over the years have been made with modest instruments. Probably the most dramatic and purposeful use of a small telescope was that of the 3-inch glass used by Argelander a century ago to compile the famous chart and catalog called the *Bonner Durchmusterung*. With this small refractor and the assistance of a few recorders, Argelander observed and charted the positions and magnitudes of 324,000 stars! The BD, as it is referred to, was recently reprinted for the second time since its initial publication—a testimony to its continuing value.

But—you say—*your* small telescope shall never fall heir to such a disciplined program as this. Your intentions are humble, and your telescope is the same? Good, for humility is at home beneath the canopy of stars, and a three-inch telescope can keep you occupied for the rest of your life. For remember, a telescope itself sees nothing, but with an intelligent and searching eye attached even a modest instrument can become a literal "window on the heavens" to view the infinite parade that passes by.

In fact, the ease of use inherent in the small refractor or reflector places it in a class of its own. During recent years the writer has used or still uses such varied instruments as a 4-inch and a 5-inch refractor and an 8-inch and 10-inch reflector, and, he hopes, with good purpose. Yet, the demands of life's pace intervene, and he continues to find himself catching fleeting moments under the stars in the company of a small 3-inch refractor. Light, steady and sure, it can be picked up in a moment and carried out into the shadows of the house, and is quite capable of dodging a neighbor's light or seeing around an interfering tree.

It's a splendid instrument! Fashioned in the early half of the 19th century by Henry Fitz of New York City, its object glass produces perfect diffraction rings about a star on steady nights. The fine yellow brass of its fixtures, the delicate taper of its dark mahogany tube, and the proud script of its maker's name all attest further to the craft which went into it. Had Henry Fitz lived to compete with the fabled Clarks of Cambridgeport, his name would perhaps be even better known.

During the brief ten years of this partnership, the writer has often wondered as to the previous century of the telescope's use. How many lifetimes has it filled with excitement and pleasure, and whose? What devious route has it traveled from Fitz' workshop in lower Manhattan to its present resting place in a suburban patio? Its optics are a bridge across the years, by which its user can share his present pleasures with the past, both in space and in time.

Of course, this is all very well but —unlike some of the other products of man's efforts to tap nature's secrets—vintage and the aging process do not necessarily guarantee qual-

ity in an optical instrument. It is quite proper to respect a piece of fine optical craftsmanship and to revere its service, but it is still the use to which it is put and the pleasure it brings that are the final measure of the glass.

Many excellent telescopes are available to the amateur astronomer today. There are more good telescopes on the market now than ever before. The best mirrors and lenses still require special attention and hand working, but modern techniques have eliminated much of the need for the long hours of painstaking drudgery —hours which often only allowed the artisan more time to compound his errors.

Now, when in the future we speak of "the three-inch," we will be speaking in general terms—speaking of any modest telescope, reflector or refractor, with which we are at home and which we can move about with ease. Its aperture will be unassuming—two to four inches, perhaps, although we will not snub the fives and sixes if they behave themselves—and we won't push the powers too high. Three inches and a 40-power eyepiece are a combination guaranteed to unlock a lifetime of celestial riches.

But now—and during the months and years to come—we will take our instruments outside and go about our business of seeing stars. There are so many to see, and so little time to see them.

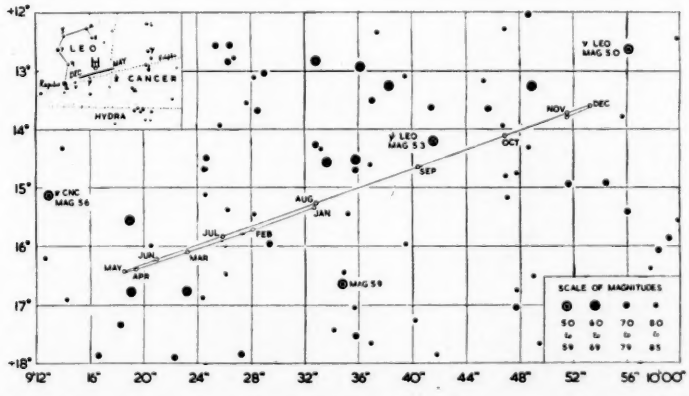
For obvious reasons—unless we live in areas where we are properly conditioned by our chambers of commerce—spring is a season of special promise to the winter-bound stargazer. In her artful way, Nature, after the cold-war hostilities of winter, does not display her heavenly charms in one sudden unveiling, but intersperses them piecemeal between nights of gusty wind and soft rain. Just when we have convinced ourselves that "spring is really here at last," an evening blanket of stratus cloud arrives to tuck us in. In Missouri, at least, spring is often a daytime season, but the fleeting peeks it allows of the observing months ahead make it a time to snatch at small favors.

Orion is already dipping his feet in the fading western twilight, and we take a last look at him as did Tennyson's dying warrior as his mind returned to "Locksley Hall":

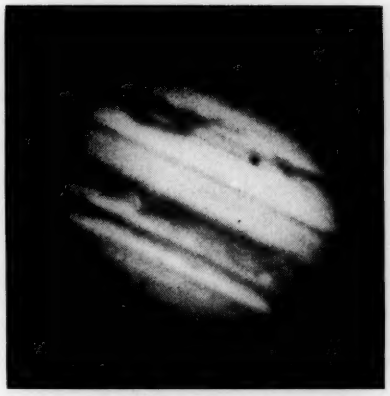
> "Many a night from yonder ivied
> casement, ere I went to rest,
> Did I look on great Orion, sloping
> slowly to the west."

Lord Tennyson was himself a seasoned amateur astronomer, and also a user of small telescopes. Shortly before he died, the poet invited a guest, the great astronomer Sir Norman Lockyer, to spend the evening observing double stars—with his two-inch refractor.

The doubles of spring offer bright fare to the telescopist. The zenith and the eastern dome are studded with superlative objects quite accessible to modest apertures. Although past the zenith and toward the west, Castor, the fainter of the Twin stars



The chart above shows the path of Uranus during 1960 among the stars of Leo and Cancer. The planet is retrograding now, its westward motion carrying it briefly into Cancer before direct motion is resumed on April 24. The small inset map shows the relation of its path to the stars in Leo; the larger chart is inverted to match the telescopic field. From the 1960 "Handbook" of the British Astronomical Association.



The cloud belts of Jupiter and the phenomena of its four brighter satellites are readily available in pre-dawn hours these days to a three-inch telescope. Notice the shadow of a satellite in transit across the planet.

Lick Observatory Photograph

of Gemini, is always a satisfying object. Use a medium power. At 4″ of arc separation and with both components of second magnitude, it will be tight in your instrument, but that is the way doubles should be seen—with just enough magnification to bring a bit of blackness between the components.

But—we have rambled tonight—and we will just have time to cover one type of object in each class. Then you will be on your own, perhaps to wander on to Mizar, the second star from the tip of the Big Dipper's handle; from there southward some 10° to beautiful and wide Cor Caroli, Alpha of Canes Venatici; and not forgetting Gamma Leonis, the brightest star in Leo's Sickle, just north of Regulus. It is also close (4″), but worthwhile. The elder Struve termed it "the finest double in the northern sky," and few have observed more binary stars than he. The Rev. Webb, in his 19th century classic, *Celestial Objects for Common Telescopes* (being readied by Margaret and Newton Mayall as a paperback reprint!), calls its components "gold and greenish red." But we will settle for yellow and green, although the green might be a contrast illusion.

While we are here at Gamma, let us take notice of the fact that Leo's Sickle has the planet Uranus nearly snared in its blade. The accompanying chart will help you locate it and follow it during the next few months. After learning its general location,

(Continued on Next Page)

XUM

(Continued from Page 5)

try to single it out among the field stars before you pinpoint it with the chart. Herschel, although he didn't define it initially as a planet, immediately picked it out in his 6-inch reflector, partly because of its greenish cast, partly because of its sensible disk. Uranus shows a disk which is the same angular size as the separations of Castor and of Gamma Leonis—4″ of arc. It will be an easy object with any optical aid, as it is just past opposition and shining at 5.7, though fading now. It is now retrograding, moving slowly westward, and is stationary on April 24th, after which it resumes its eastward motion.

Just a few years ago, Uranus was sailing s l o w l y and majestically through Praesepe, the fine open cluster in Cancer which you may know as "the Bee-hive." Look for it beyond Leo's outstretched paws, forming the apex of a tall isosceles triangle with Regulus and Gamma Leonis at the base. Scarcely contained by the faint quadrilateral in Cancer, Praesepe is a joy at low powers. It contains some 350 stars, and recent estimates place it at nearly 500 light years, about the same distance as the Pleiades. Praesepe was one of the first objects examined by Galileo, who announced in his *Sidereus Nuncius* in 1610 that it was "not one star, only, but a mass of more than 40 small stars." It is a galactic cluster, and its apparent distance from the plane of our Milky Way galaxy stems from the fact that it is really quite close, so that its actual linear distance from the galaxy's plane is slight.

But now, the limitations of editorial space must take precedence over the boundlessness of outer space. These should, however, be an eventful two months for our telescopes. As you will read elsewhere in these pages, we will have available a comet, possibly rather bright as comets go, an occultation of a first-magnitude star, and a weekend total eclipse of the moon. Good seeing!

—DDZ

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Box 213
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An enlarged section of a photo of Comet Burnham 1959k made Jan. 28th at the Flagstaff Station of the Naval Observatory. Photo was taken with the 40-inch reflector by Dr. Elizabeth Roemer. Official U. S. Navy Photograph.

COMET BURNHAM 1959k

According to information reaching the SKY MAP at publication, it is quite possible that spring skies will feature a new naked-eye comet. The new comet is the fifth discovered by Robert Burnham, Jr., an Arizona amateur astronomer now turned professional, in little more than two years. At its discovery late last year the comet was quite faint, but, according to a recent ephemeris by Dr. B. G. Marsden of the Yale Observatory, the object may brighten to the 3rd magnitude at its closest approach to earth after passing the sun on March 20th. The comet should pass within about 0.2 astronomical unit (20,000,000 miles) of the earth on about April 26th.

The accompanying chart, prepared from the ephemeris cited above, indicates that Comet Burnham (1959k) will become accessible to small instruments during the middle of April. At perihelion point on March 20th the comet will be some 27° south of the Square of Pegasus, but will shortly afterward begin an increasingly rapid motion to the north which will carry it across the bowl of the Little Dipper in late April and the bowl of the Big Dipper in early May.

By early April Comet Burnham should be visible as a pre-dawn morning object low in the east, but later in the month it becomes circumpolar and thus visible morning and evening.

Mr. Burnham, who discovered the comet during his current photographic survey work at the Lowell Observatory, Flagstaff, Arizona, informed the SKY MAP that he had observed it on Feb. 6th and found it to be about 9th magnitude. He indicated, however, that the predicted magnitudes after perihelion, which are based on a standard formula, might be a bit too bright, according to opinion of Lowell Observatory astronomers.

In commenting on the accompanying photograph, Mr. Burnham had the following to say: "The long, straight tail which appears on this plate seems to be developing rather rapidly, as it is scarcely visible on plates taken four days previously. A close examination of the print will show the beginnings of a second,

more diffuse tail, just back of the head and to the right of the main tail. This suggests that 1959k may have two tails like Mrkos 1957d; a gaseous tail and a dust tail."

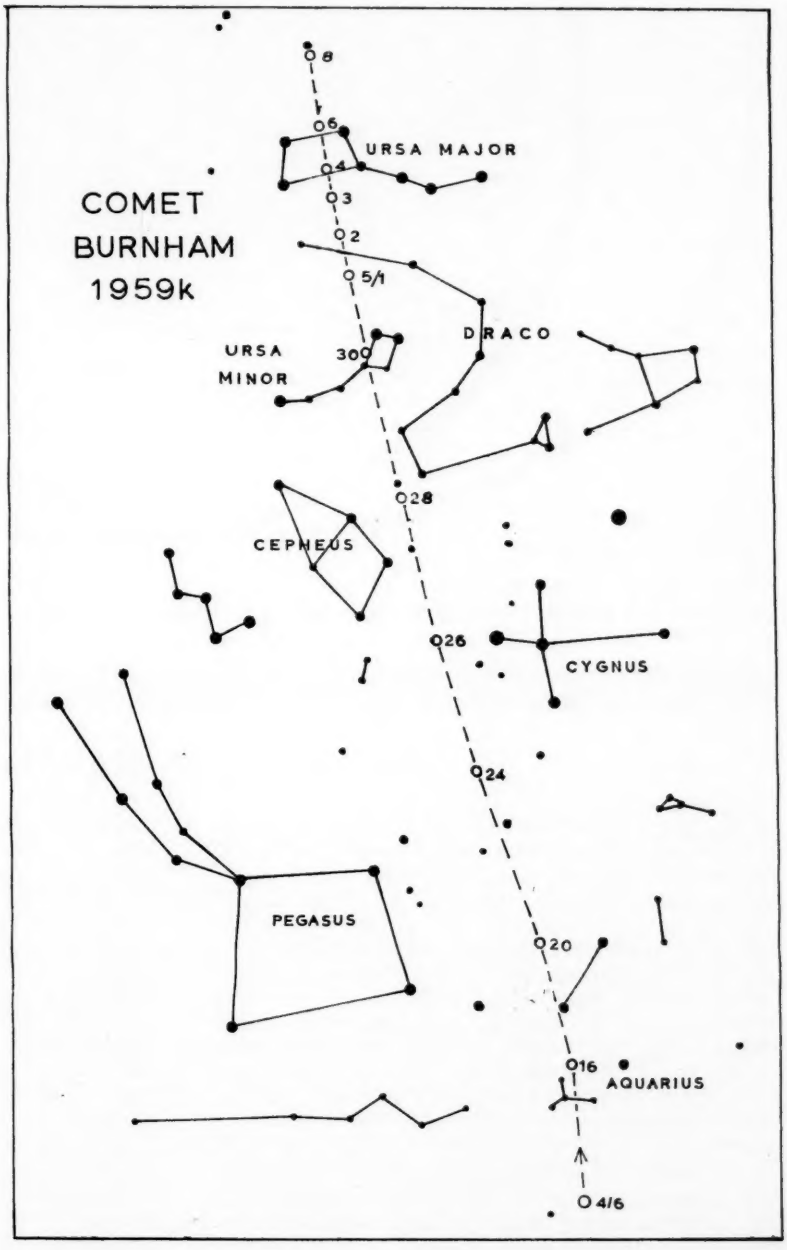
The main tail is quite pronounced on the original photograph, although some contrast is lost in reproduction, and a rough measure indicates that the tail was about one-fifth of a degree in length at the time the photograph was made. The secondary tail, though rudimentary, is also visible. Mr. Burnham's comparison to Comet Mrkos 1957d refers to the bright summer comet of that year which developed a second tail and, for a short time, a third. However, the initial tail of Comet Mrkos 1957d was broad, fan-shaped and curving, while the secondary tail was thin and straight, just the reverse of the apparent development of Burnham 1959k. This would suggest that straight tails develop from material scattered behind the comet when it is in the same orbital plane as the earth, and that curved tails develop when these orbital planes are not coincident.

Mr. Burnham, who lives in Prescott, Arizona, discovered his first comet in October, 1957, with a home-made six-inch reflector. He shared this discovery with Wild in Switzerland, but discovered another of his own with an eight-inch instrument the following February. He had just completed four years of duty with the Air Force prior to his first discovery, but then joined the staff of the Lowell Observatory to work on the continuing Lowell proper motion survey using the 13-inch photographic refractor, with which he and a colleague, Charles Slaughter, found two more comets.

This is much the same story as that of Clyde Tombaugh, a young man whose planetary drawings with a home-made telescope brought him to the attention, and later the staff, of Lowell. He was assigned to a photographic survey with the same instrument Burnham is using now, and just 30 years ago this month his important discovery was announced to the world—the new planet Pluto!

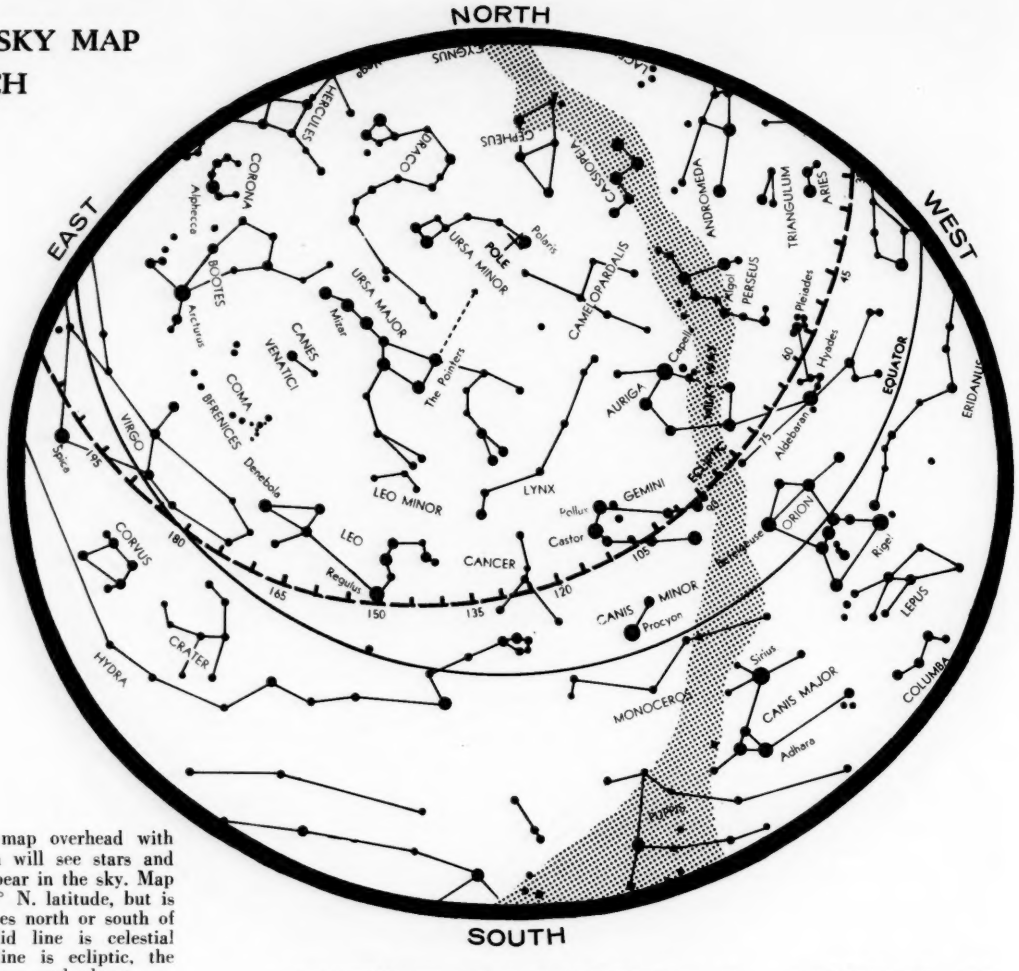
Coincidence seems to be the order with Mr. Burnham. When asked about the name he shares with another eagle-eyed astronomer, S. W. Burnham, the Yerkes and Lick double-star observer, the current Mr. Burnham admits that he has been asked about this before. He disclaims any blood relation, but his last two years indicate that he is at least an observer of promise. Mr. Burnham exhibited some confusion when the SKY MAP contacted him to learn further details about his late-1959 discovery. It turned out that he had discovered a *sixth* comet on January 20, 1960, and didn't know which comet we were inquiring about.

The new comet, Burnham 1960a, was fading in brightness at discovery (14th mag.), but according to its orbit it should have been fairly bright last summer in the Southern Hemisphere. It escaped notice, however, at least until Burnham picked it up in January just west of the Hyades.



The chart at right shows the approximate path of Comet Burnham from April 6 to May 8. In March and early April the comet will be too close to the sun for observation.

EVENING SKY MAP FOR MARCH



Face south, hold map overhead with north at top. You will see stars and planets as they appear in the sky. Map is designed for 40° N. latitude, but is practical ten degrees north or south of that latitude. Solid line is celestial equator; dashed line is ecliptic, the apparent path of sun and planets.

10:00 P.M., Mar. 1 9:00 P.M., Mar. 15 8:00 P.M., Mar. 31

MARCH AMONG THE PLANETS

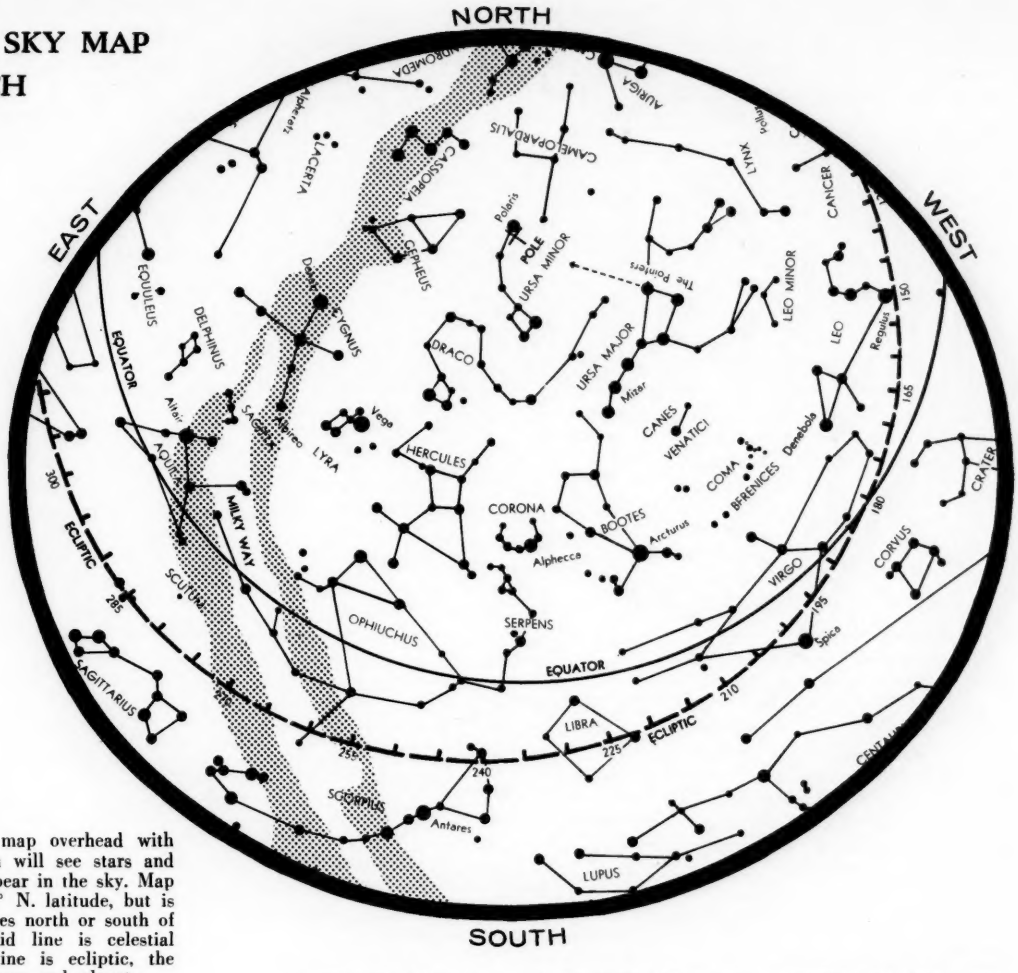
THE SUN: On the 20th of March at 9:43 a.m. the sun moves northward across the celestial equator, and spring begins (astronomically speaking). The earth's orbital motion causes the sun to move through Aquarius and into Pisces during January, although the solar orb is said to be "entering the sign of Aries, the Ram." Over the centuries, the precession of the equinoxes has caused "the first point of Aries," as navigators call it, to move back to a point in Pisces, but the term is still used to define that point at which the sun, moving northward, crosses the equator at the vernal equinox. It is the zero point for measuring right ascension and hour angle on the celestial equator, as well as celestial longitude of planetary bodies along the ecliptic.

THE MOON: (See Astronomical Calendar for phases and conjunctions. *Eclipse March 12-13; see page 11)* On March 4th the first-quarter moon occults the 1st magnitude star in Taurus, Aldebaran. Although the occultation takes place before the end of evening twilight, the phenomenon should be visible with slight optical aid. The occultation is generally observable throughout the eastern half of the United States.

Aldebaran will disappear behind the dark eastern limb of the moon. The following times of disappearance and reappearance are given for certain key points in the United States and Canada for which occultations are predicted. Observers in adjacent areas should interpolate between stations for approximate times of beginning and ending. Locate the star some time in advance, however. (Times given are all p.m.)

PLACE	DISAPPEARANCE	REAPPEARANCE
Central Mass.	6:40 EST	8:08 EST
Montreal	6:38 EST	8:03 EST
Washington, D. C.	6:32 EST	8:01 EST
Toronto	6:26 EST	7:55 EST
West-Central Ill.	5:00 CST (Daylight)	6:32 CST

MORNING SKY MAP FOR MARCH



Face south, hold map overhead with north at top. You will see stars and planets as they appear in the sky. Map is designed for 40° N. latitude, but is practical ten degrees north or south of that latitude. Solid line is celestial equator; dashed line is ecliptic, the apparent path of sun and planets.

5:00 A.M., Mar. 1 **4:00 A.M., Mar. 15** **3:00 A.M., Mar. 31**

MARCH AMONG THE PLANETS

West of these points even the reappearances are in daylight and are therefore of little interest.

MERCURY: In Aquarius at mid-month, and unobservable. Inferior conjunction on the 10th.

VENUS: Moves from Capricornus into Aquarius during March, still shining brightly at –3.3 but too low in the southeast at dawn to be accorded full honors.

MARS: In Capricornus and uninteresting in the morning twilight sky.

JUPITER: In Sagittarius and rising in the early morning hours. It is already a splendid object for early dawn observation. The giant planet shows a disk with an equatorial diameter of 38 seconds of arc, although it is nearly 500 million miles from the earth. (See chart on next page for phenomena of its satellites.)

SATURN: East of Jupiter in Sagittarius, rising an hour later but not so bright as Jupiter. Saturn's ball this month is just 16 seconds of arc across, but its rings more than double its size—presently 36 seconds from tip to tip.

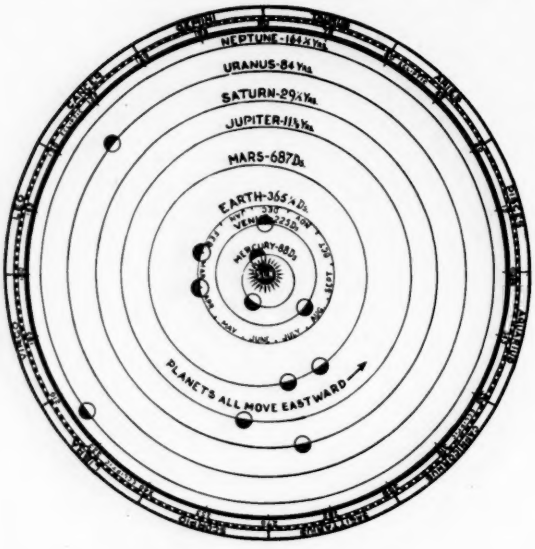
URANUS: Uranus as in Leo, just west of Regulus and the Sickle. The planet, which just passed opposition with the sun last month, is now moving to the west against the star background, or retrograding. The accompanying chart will help you to locate Uranus during the next few months.

NEPTUNE: Now visible in the late evening sky between Virgo and Libra. A greenish object in a small telescope, but does not show a disk until large apertures are applied. Magnitude is about 7.7, diameter nearly 2.5 seconds of arc. In opposition next month.

PLUTO: Past opposition in Leo, but too faint for telescopic interest.

XUM

HELIOCENTRIC POSITIONS OF THE PLANETS, MARCH



The solar system as it would appear if viewed from a point directly above (in relation to the plane of the ecliptic) the sun. Heliocentric positions are actually measured in degrees of longitude from the center of the sun. Owing to scale, orbits of outer planets do not reflect true size. Positions at beginning and end of month are indicated for Mercury, Venus, Earth, and Mars, the others for their mean position during month.

ASTRONOMICAL CALENDAR

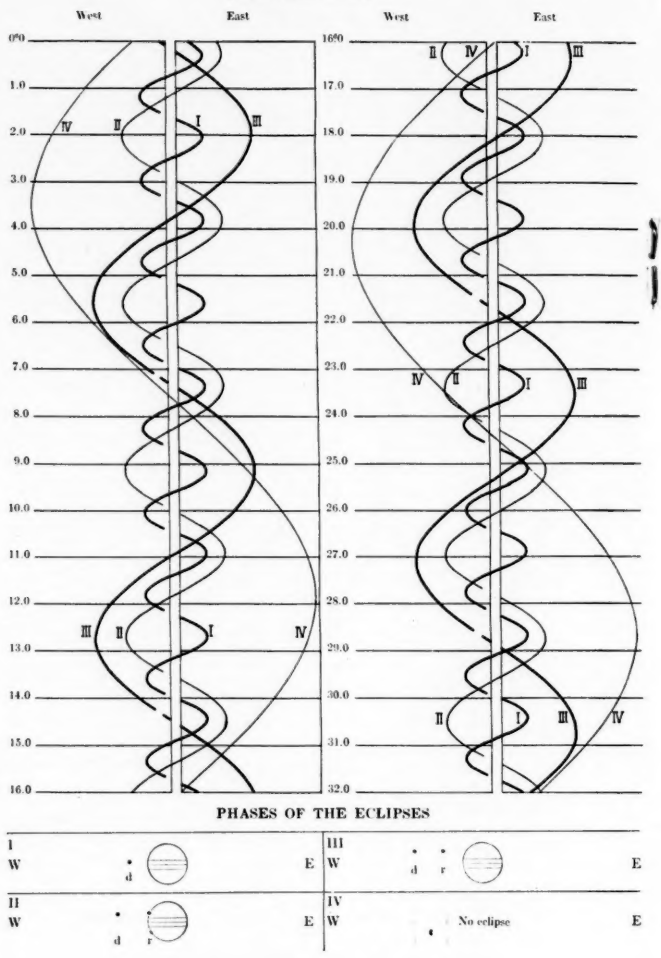
MARCH 1960 Eastern Standard Time

Date	Hour	
4 Friday	19h	Aldebaran 0°.4S. of moon *(Occultation, see preceding pages)*
5 Saturday	6h	Moon at first quarter
	21h	Moon at apogee
10 Thursday	13h	Uranus 4° N. of moon
	16h	Mercury at inferior conjunction
13 Sunday	3h	Full Moon *(Total lunar eclipse; see page 11)*
16 Wednesday	11h	Neptune 2° S. of moon
19 Saturday	5h	Moon at perigee
20 Sunday	2h	Moon at last quarter
	6h	Jupiter 5° south of moon
	10h	Vernal equinox
21 Monday	9h	Saturn 4° S. of moon
23 Wednesday	2h	Mercury stationary
	23h	Mars 4° S. of moon
25 Friday	4h	Mercury 1°.9 N. of Venus
	7h	Mercury 0°.7 S. of moon
	7h	Venus 2° S. of moon
27 Sunday	3h	New moon (total eclipse of sun; invisible in America)

SATELLITES OF JUPITER

MARCH, 1960

(Universal Time)



EXPLANATION OF SATELLITE DIAGRAM

Effective with the unification of the British and American Nautical Almanacs this year, the configurations of Jupiter's bright satellites are now presented in a new and more useful type of diagram.

The central vertical band in the diagram represents the equatorial diameter of the disk of Jupiter. The relative positions of the satellites at any time with respect to the disk of Jupiter are given by the curves. In cases where a satellite is immersed in the shadow of Jupiter or occulted by its disk, the curve is interrupted.

The horizontal lines show the positions of the satellites at 0h Universal Time (Greenwich Mean Time) for each day of the month. For example, the horizontal line for the 15th of this month would show the positions of the satellites at 7:00 p.m. on the 14th of the month for an observer in the Eastern Standard Time zone.

The diagrams at the bottom show the point of disappearance (d) into the shadow or the reappearance (r) from the shadow of each satellite (when appropriate) for the middle of the month.

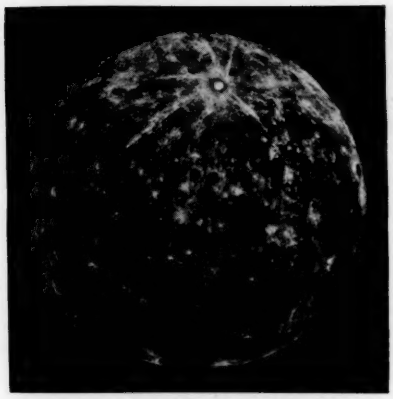
(Diagram taken from 1960 *American Ephemeris and Nautical Almanac.*)

TOTAL LUNAR ECLIPSE IN MARCH

On the night of March 12-13, viewers in most of the Western Hemisphere will have an opportunity to observe a total eclipse of the moon. Circumstances of this lunar eclipse are especially favorable, since the moon will be high in the sky for United States observers and the eclipse itself will occur on a Saturday night. Barring cloudy skies, the phenomenon should be widely observed.

A total eclipse of the moon occurs only when the moon is full. Full moon is the equivalent of a lunar opposition, and from the moon the earth is in inferior conjunction with the sun. At this time, when the sun, the earth and the moon are in line, the shadow of the earth blots out the sun as observed from the moon and a lunar eclipse occurs. From the moon, of course, there would be an eclipse of the sun by the earth, and it is this effect which will be viewed on March 12-13.

The first darkening of the moon by the outer, penumbral shadow will not be readily evident, for the light of the sun is still illuminating the moon's surface too brightly. An observer on the moon in the area covered by this penumbral shadow would see the sun partially eclipsed. The



The moon as it will appear just before the eclipse. Watch for visibility of lunar ray systems as eclipse progresses. Major features of lunar surface should remain visible during totality. Lick Observatory Photograph

first evidence of the approaching eclipse will be a darkening of the moon's eastern limb shortly before the inner, umbral shadow makes its first contact. An observer within the umbral shadow would see the sun in total eclipse.

The following schedule of events on March 12-13 is modified from tables in the 1960 *American Ephemeris and Nautical Almanac*, and the times used are Eastern standard. To convert to Central standard time, subtract one hour; to Mountain standard, subtract two hours; to Pacific standard, subtract three hours.

Moon enters penumbra	0:34 a.m.
Moon enters umbra	1:38 a.m.
Total eclipse begins	2:41 a.m.
Middle of eclipse	3:28 a.m.
Total eclipse ends	4:16 a.m.
Moon leaves umbra	5:18 a.m.
Moon leaves penumbra	6:22 a.m.

Owing to refraction and scattering of the sun's light by the atmosphere of the earth, the moon is at no time completely blotted out during a total eclipse. The moon takes on a dark, reddish cast, but the degree of this reddening varies from eclipse to eclipse. Since the moon will be passing almost directly through the center of the shadow cone, this eclipse will have a total phase lasting 1h 35m, longer than most. It will be interesting to see what effect this has on the darkness of the eclipse. However, solar activity probably influences this more directly.

Observations can be carried on with the naked eye, binoculars and small telescopes. Naked-eye observers should note the extent of sharpness of the edge of the dark umbral shadow at its first and last contacts, the color of this shadow and the degree of its obscuration of the lunar surface. Telescopic observers will want to record the times of contact as closely as possible and look for any changes in lunar features, especially in craters, as the umbral shadow enters or leaves the area.

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YOUR TELESCOPE AND MINE

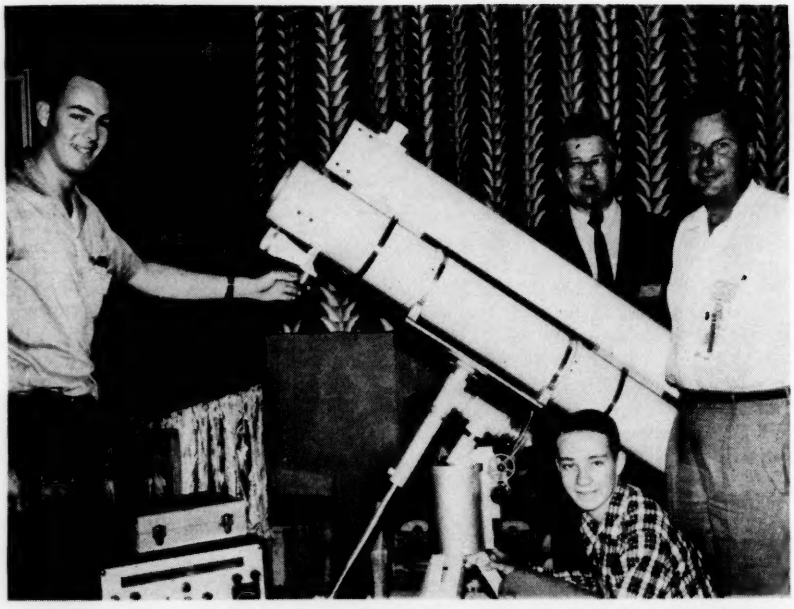
THOMAS R. CAVE, JR.

In this issue, we shall digress somewhat from tips on telescope making and delve into the actual performance of your telescope. The late Albert G. Ingalls, great sage of the amateur telescope maker, once mentioned personally to this writer, "Probably few amateur makers ever realize just how well a Newtonian reflector can perform."

The actual star-image diffraction pattern and the quality of planetary definition is the final, conclusive tests for any telescope large or small. Many telescopists expect too little from a small instrument and some observers too much from a larger telescope. A small telescope of finest quality will actually render on many clear nights "classical" diffraction images of stars with 50X to 100X per inch of aperture. Larger telescopes of 12″ to 24″ aperture, and of equally fine quality, will seldom reveal these classical diffraction star images, and almost never so clearly defined.

The primary reason is, of course, "seeing", since there are very few locations on the earth where our atmosphere is sufficiently tranquil for optimum performance by these larger telescopes. However, the simple fact that a larger aperture will not usually give perfect diffraction images does not mean that a larger telescope will not perform very well. In his famous book, *The Testing of Telescope Objectives*, H. Dennis Taylor states that probably no telescope of over 12″ aperture exists that will give the classical diffraction patterns of a well made 3″ or 4″ refractor. And Taylor was referring to a 12″ refractor which had unusually fine Hartmann-test curves.

The telescopist should *expect* perfect classical diffraction patterns in his 3″ to 6″ telescope. When focusing his high-power ocular about one millimeter inside and then outside focus, he should see almost identical images. These are technically called extra-focal images. If his instrument is a refractor, he will notice definite color differences each side of focus, but the expanded star image should appear very nearly the same. Should his telescope be a reflector, he will notice the same effect but free of color changes. There will also appear in the reflector the black shadow-image of the diagonal or secondary mirror in the center of the expanded star image. When the optical system of the reflector has reached the temperature of the surrounding air, and if the telescope is exceedingly close to a perfect figure, the shadow of the flat and expanded diffraction rings will be almost identical each side of focus. Theoretically they should appear exactly the same; however, in practice the inside-focus image will always appear softer than the outside image.



Tom Cave (right) and Walter Houston (with pipe) inspect photographic telescope at 1959 Western Astronomers—Astronomical League Convention in Denver last August. The main telescope, an f/8 6-inch reflector with a 4-inch guide telescope, incorporates a variable frequency control into its clock-driven equatorial mounting, and was designed and constructed by Darrell Bennett (standing) and his brother Brenton (kneeling), both members of the Los Angeles Astronomical Society.

For many years this optical effect was unexplained, but quite recently F. J. Hargraves of England found the solution. In effect this is now believed due to a very slight variation in the temperature of the air within the telescope tube. The slightly cooler air lying just above the mirror and the warmer air at the open upper end of the tube cause an "air lens" effect, which acts much the same as a large but very weak meniscus lens placed just in front of the telescope mirror.

A question often asked is "How much should my telescope reveal in fine detail on the moon and planets?" If you have a first-class Newtonian reflector of 6″ to 12″ aperture, you should, on a night of good seeing, see several of Jupiter's cloud belts sharply defined and a considerable amount of fine detail in the equatorial and temperate zones of the planet when using 200X to 400X.

The ring system of Saturn is also an excellent definition test. The crape ring should be easy, the Cassini division hard and sharp; the Encke division in the outer ring should be visible but fainter and less sharp than Cassini's. To the trained observer viewing Mars near any opposition, the main dark *maria*, the polar cap and some canal-type detail should be visible; under good conditions at

least as clearly as the best photographs of Mars.

Two excellent and difficult tests on the moon are the five largest shadow-containing craterlets on the floor of Plato, best seen when the terminator is one day past Plato. The so-called "Pickering double canal" in Aristillus, which can just be resolved as two fine line faults from the top of the crater rampart down the inside crater wall to the floor. This last lunar test requires at least an eight-inch aperture.

Even though the small telescope classical images are seldom seen in larger apertures, double stars should be resolved close to the empirical limit of the aperture, if they are of equal magnitude and not too bright. The famous double star Castor, beautiful and easy in a fine three-inch telescope, often loses much of its sharpness and beauty in any 12″ or larger telescope simply because of irradiation, or excessive brightness of the star images.

In the next issue we shall discuss methods of improving the definition and performance of your telescope.

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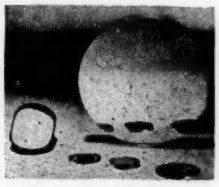

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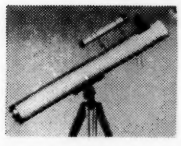

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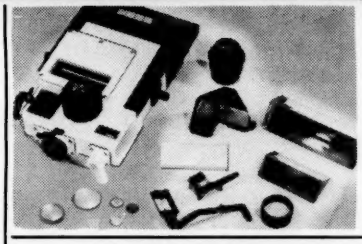

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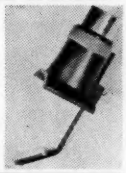

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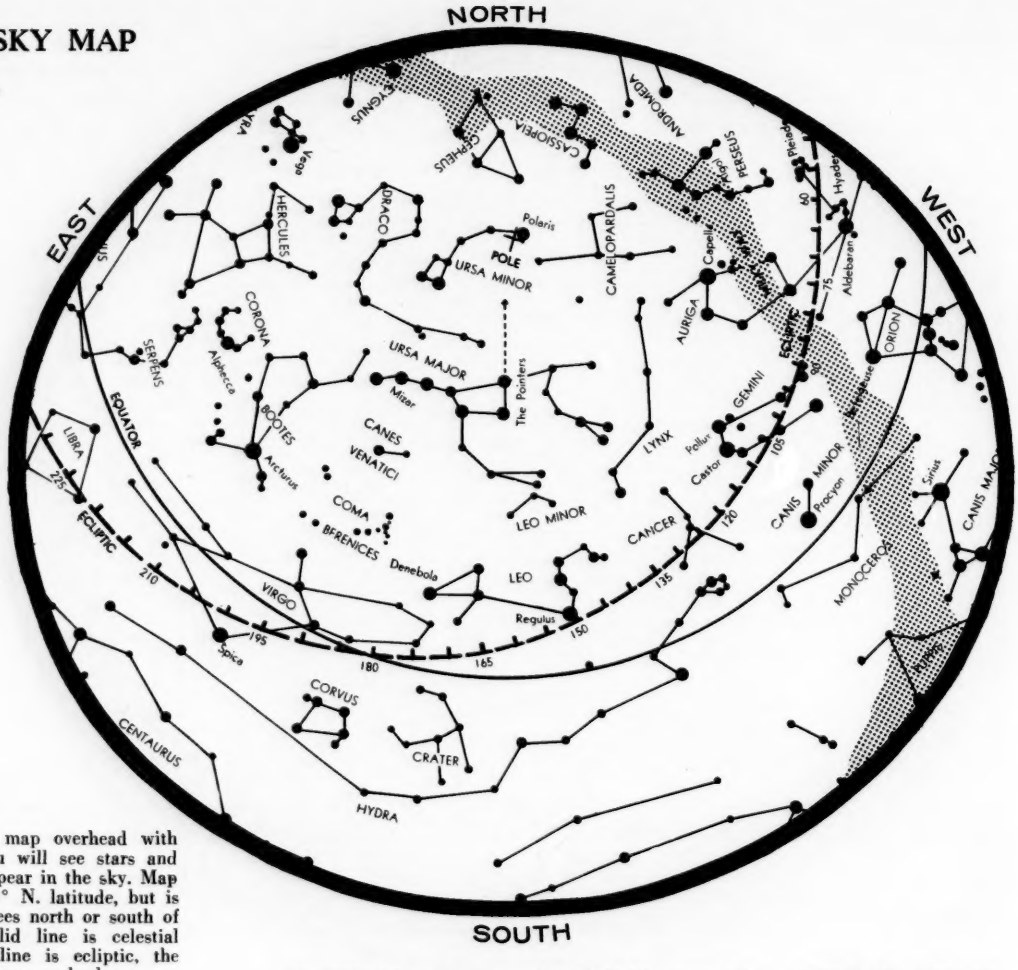
EVENING SKY MAP FOR APRIL



Face south, hold map overhead with north at top. You will see stars and planets as they appear in the sky. Map is designed for 40° N. latitude, but is practical ten degrees north or south of that latitude. Solid line is celestial equator; dashed line is ecliptic, the apparent path of sun and planets.

11:00 P.M., Apr. 1 10:00 P.M., Apr. 15 9:00 P.M., Apr. 30

APRIL AMONG THE PLANETS

THE SUN: The sun moves from Pisces into Aries during April, and by the end of the month it is 15° north of the equator.

THE MOON: (See Astronomical Calendar for phases, conjunctions, etc.)

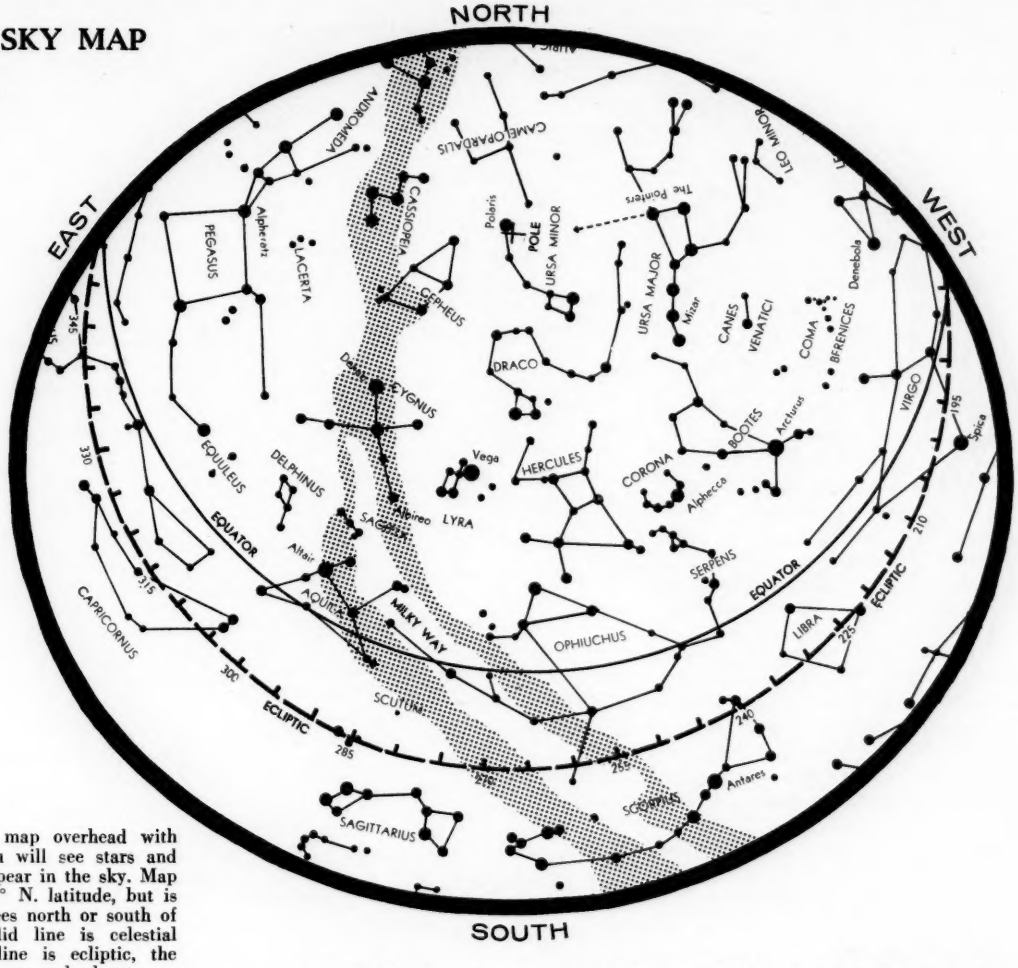
MERCURY: In greatest western elongation on the 7th of April, and may be spied low in the southeastern sky just before sunrise a few days before and after this date. However, since Mercury is practically on the equator, this elongation is unfavorable for United States latitudes. The planet's disk is about half-illuminated, magnitude 0.5.

VENUS: Venus is now too near the rising sun for easy observation. If you spot Mercury, look a few degrees east for Venus. Binoculars may help. Its disk is small (10″), nearly at "full" phase, and shines at –3.3.

MARS: In Aquarius, and now well up in the southeast by sunrise. Only 5″ of arc at month's end, however, and just barely a 1st-magnitude object.

JUPITER: In Sagittarius, and stationary on the 20th, after which it begins its western retrograde motion among the stars. It has an equatorial diameter of more than 40″ of arc during the month, and shines brightly in the morning sky at –2.0 by the end of April. You will notice in checking the accompanying chart of Jupiter's satellite phenomena that satellite III, Ganymede, undergoes a complete eclipse disappearance and reappearance *before* being occulted by the planet. This occurs because the planet's shadow is now far to the west, so that Ganymede passes through the shadow before it passes from view behind the planet. Unfortunately, none of these eclipses are generally visible in the United States. A similar set

MORNING SKY MAP FOR APRIL



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5:00 A.M., Apr. 1 **4:00 A.M., Apr. 15** **3:00 A.M., Apr. 30**

APRIL AMONG THE PLANETS

of *east* limb eclipses will occur several months *after* opposition.

SATURN: In Sagittarius just east of Jupiter, and thus goes into retrograde motion on the 27th, just a week later. The rings are an apparent 38″ of arc across, and Saturn's magnitude is 0.7.

URANUS: Readily visible with a little optical aid west of the Sickle in Leo. (See page 5 for chart and details.)

NEPTUNE: At opposition on the 27th in Libra, rising shortly after dark and visible all night long. Nearly an 8th magnitude object, and not impressive until you realize that it is some 2,725,000,000 miles away from the sun.

PLUTO: In Leo, but not worth fooling with unless you happen to live on Palomar Mountain.

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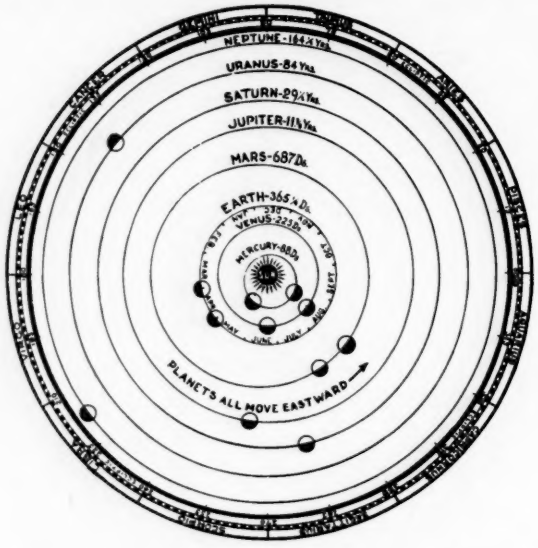
HELIOCENTRIC POSITIONS OF THE PLANETS, APRIL



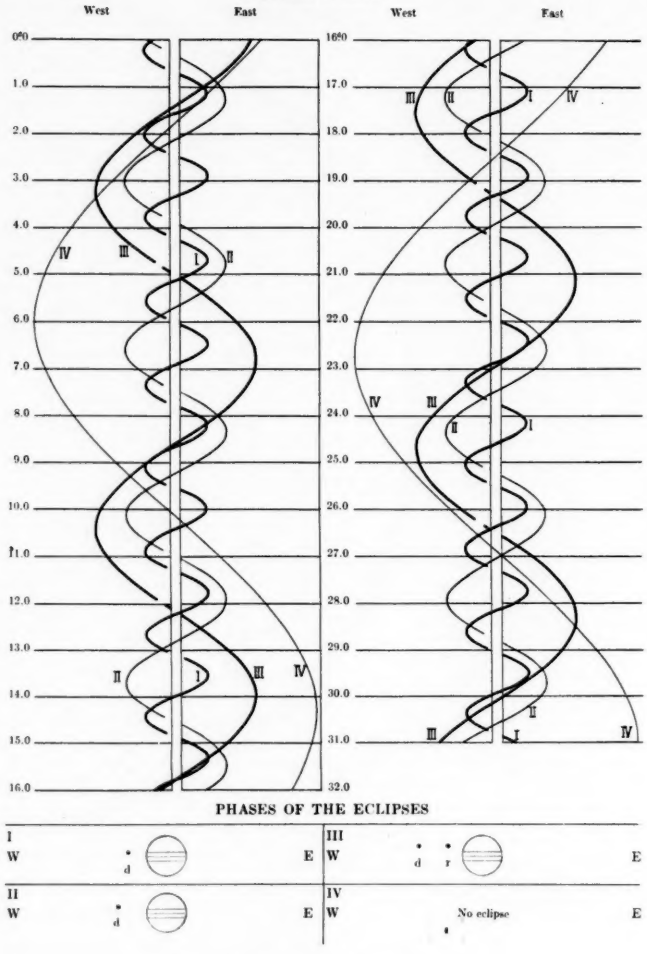
The solar system as it would appear if viewed from a point directly above (in relation to the plane of the ecliptic) the sun. Heliocentric positions are actually measured in degrees of longitude from the center of the sun. Owing to scale, orbits of outer planets do not reflect true size. Positions at beginning and end of month are indicated for Mercury, Venus, Earth, and Mars, the others for their mean position during month.

ASTRONOMICAL CALENDAR

APRIL 1960 Eastern Standard Time

Date	Hour	
1 Friday	3h	Aldebaran 0°.4 S. of moon
2 Saturday	17h	Moon at apogee
4 Monday	2h	Moon at first quarter
6 Wednesday	21h	Uranus 4° N. of moon
7 Thursday	6h	Mercury greatest elongation west (28°)
11 Monday	15h	Full moon
12 Tuesday	18h	Neptune 2° S. of moon
14 Thursday	14h	Moon at perigee
16 Saturday	14h	Jupiter 5° S. of moon
17 Sunday	16h	Saturn 4° S. of moon
18 Monday	8h	Moon at last quarter
20 Wednesday	0h	Jupiter stationary
21 Thursday	20h	Mars 2° S. of moon
23 Saturday	20h	Mercury 1° S. of moon
24 Sunday	8h	Venus 0°.7 N. of moon
	8h	Uranus stationary
27 Wednesday	21h	Neptune at opposition
30 Saturday	11h	Moon at apogee

SATELLITES OF JUPITER
APRIL, 1960
(Universal Time)



PHASES OF THE ECLIPSES

EXPLANATION OF SATELLITE DIAGRAM

Effective with the unification of the British and American Nautical Almanacs this year, the configurations of Jupiter's bright satellites are now presented in a new and more useful type of diagram.

The central vertical band in the diagram represents the equatorial diameter of the disk of Jupiter. The relative positions of the satellites at any time with respect to the disk of Jupiter are given by the curves. In cases where a satellite is immersed in the shadow of Jupiter or occulted by its disk, the curve is interrupted.

The horizontal lines show the positions of the satellites at 0h Universal Time (Greenwich Mean Time) for each day of the month. For example, the horizontal line for the 15th of this month would show the positions of the satellites at 7:00 p.m. on the 14th of the month for an observer in the Eastern Standard Time zone.

The diagrams at the bottom show the point of disappearance (d) into the shadow or the reappearance (r) from the shadow of each satellite (when appropriate) for the middle of the month.

(Diagram taken from 1960 *American Ephemeris and Nautical Almanac.*)

BOOK REVIEW

THE SKY OBSERVER'S GUIDE—(Golden Press, Inc., New York, 1959; Margaret and Newton Mayall, John Polgreen and Jerome Wyckoff; 125 pages; $2.95.)

A quick perusal of these pages shows that the reader is in the hands of experienced astronomical observers. Margaret Mayall, a Harvard-trained astronomer, is Director of the American Association of Variable Star Observers, an old and respected group of amateur and professional astronomers who follow the erratic fluctuations of certain enigmatic stars. Mrs. Mayall, together with her husband, Newton Mayall—an experienced amateur—has written or edited several important astronomical books which are standard on every amateur's shelf. Jerome Wyckoff, a Golden Press editor but also an observing member of the AAVSO, furthered the success of this collaboration, which was completed by illustrator John Polgreen and his wife, both of whom are also active members of the AAVSO!

The Sky Observer's Guide does not pretend to be a text. There are possibly other sources at this level offering equally satisfactory information of a textual nature. There is little to criticize in the coverage of the nature of the solar system, the stars of our galaxy, and the other galaxies beyond. The value of this book lies in its coverage of *observing techniques*—how to use a telescope, binoculars and the eye to best advantage. This subject is usually relegated to a separate chapter in standard handbooks; in this one it becomes part and parcel of every chapter.

The writers know what the beginning amateur needs—the information, the equipment, and the accessories. They carry the reader through all phases of the amateur observer's activity, opening up new fields for him as he goes. Astronomical photography is well-covered; the important discipline of sketching sky objects is discussed at some length in a special chapter. The selection, operation and maintenance of telescopic equipment is given several chapters. The use of star charts is clearly explained. Throughout the book, the reader is put in touch with the exciting world of astronomy as it is today.

One of the happiest facts about this book is the excellence and accuracy of its illustration. With full-color lithography at his fingertips, the illustrator has used it often and well, resisting at every turn the temptation to turn Jupiter and Saturn into barber poles and render Mars a gaudy red. In every case, color is used to enhance a graphic explanation, not to compete with it. The illustration and design of this book would, in itself, make it unusual and praiseworthy.

Considerable space has been given to this book, but for good reason. For an effort of its level and scope, it is unique among books in print. Every reader of this magazine can benefit from its ownership.

And incidentally, through a special arrangement with the Golden Press, the AAVSO is selling copies of *The Sky Observer's Guide* directly from its offices in Cambridge, Mass. Commissions will go to the growing AAVSO Endowment Fund, which enables this organization to continue and expand its half-century of observational work. If you plan to purchase the *Observer's Guide*, send your check or money order to:

The American Association of
Variable Star Observers
4 Brattle Street
Cambridge 38, Massachusetts

And, off the record, we suspect that an accompanying request will bring the autographs of the authors.

—D.D.Z.

METEOR FRAGMENTS

By Edwin E. Friton

For the observer who is watching for spectacular meteoric displays, these two months rarely offer much. However, to the serious observer, all months offer opportunity for the acquisition of truly valuable scientific data. March has only a few minor showers, and these are not even mentioned in most lists. They are generally so weak that it is difficult to detect them among the seven-per-hour average rate of sporadic (incidental) meteors.

April holds a little more hope—the Lyrids. These radiate from a point near 18h 4m right ascension and north declination 33°, which is 8° southwest of the bright star Vega. Curiously, this point is actually in Hercules, near the border between that constellation and Lyra.

The history of the Lyrids indicates that, at best, great showers from this stream are produced only at rare and unpredictable intervals. The earliest records show that this shower was known as early as about 540 B.C. Chinese records (Lovell, *Meteor Astronomy*) indicate a very high rate in 15 B.C. The last great shower occurred in 1803, when it is reported that one observer counted 167 in a period of 15 minutes, and could not manage to count them all. The last notable shower was in 1922, when a rate of 96 per hour was recorded in Greece by H. N. Russell.

During recent years, rates have been low to moderate. Dr. P. M. Millman, in *The Observer's Handbook 1960* (RASC), gives 15 per hour at maximum (April 21-22) from which the general rate of seven per hour for sporadic meteors must be subtracted. He gives the duration as 2.3 days, which is defined as the period from one-quarter maximum strength before, to one-quarter strength after maximum. These predictions of rates on the Lyrids are never to be taken as firm. That this is true may be inferred readily from their history. The fact that the rates have been highly variable without even a satisfactory explanation makes the Lyrids a very important shower to study.

Simple naked-eye counts, giving the number of meteors seen by a single observer per hourly period, the date, station, the direction and angular altitude of the center of the observed field are very valuable. This data should, of course, be accompanied by information about any impediments such as haze, moonlight, artificial light in the sky or in the neighborhood, as well as notes on any obstructions such as hills, trees, and buildings. On the 21-22 date the moon will not interfere seriously, as it will be about three days past last quarter and will not rise until 3:00 a.m. at latitude 40° north.

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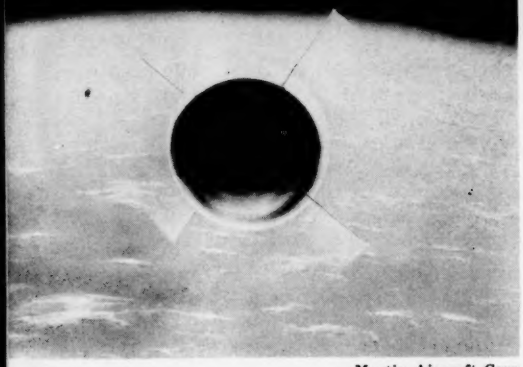

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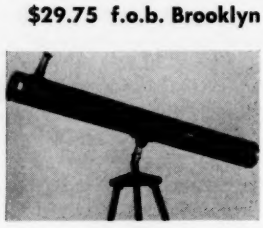

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. . . I have had many years of experience in astronomy, and as junior leader here in Atlanta I always recommend Dynascope. —LEONARD B. ABBEY, Jr., Decatur, Ga.

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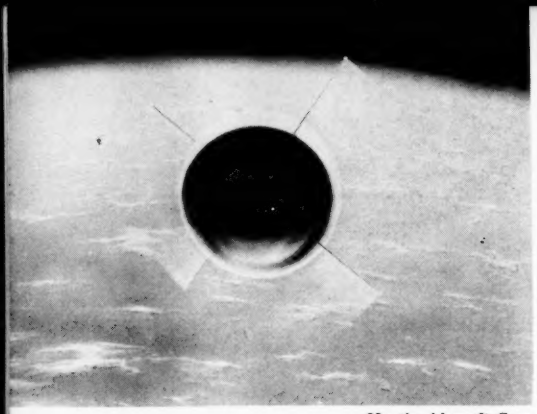

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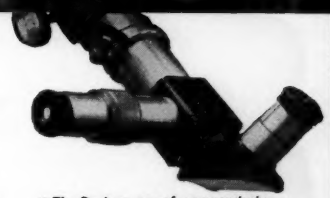

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